AFOSR 69-1TR

FINAL TECHNICAL REPORT

STUDIES OF AIR-BORNE ORGANISMS RETRIEVED BY LARGE AIRCRAFT
1 Feb. 1967--31 July 1969
AF-AFOSR-1240-67

Commencing in February 1967, a two-and-a-half year grant from the Air Force Office of Scientific Research made possible continuation of the project entitled, "Studies of Air-borne Organisms Retrieved by Large Aircraft." The main objective was to operate a trapping program, utilizing an air plankton retriever (see Fig. 1: exterior view--intake-exhaust ducts; Fig. 2: interior view--chamber and storage box) and other special collecting devices installed in a WV-2 aircraft of the Pacific Missile Range Facility, based at Pt. Mugu, California, for the purpose of collecting all types of air-borne organisms and particles in the Pacific area. The Museum's primary interest was trapping air-borne arthropods to further test the theory of natural air dispersal of arthropods to oceanic islands, a program which the Department of Entomology has been engaged in for many years.

The Museum developed an air plankton retriever in 1960 built by Lockheed Aircraft Co. and funded by two branches of the National Science Foundation. After several years of operation in the Antarctic area, the trap was found to be functioning inefficiently. Results of a wind-tunnel test provided more information about the trap and enabled planning of the addition of other specific collecting devices in order to augment the trap's function to collect quantitative samples of various microbiological and mineralogical specimens at various altitudes. A grant from the National Institutes of Health and support received from the Office of Naval Research, the U.S. Navy, and Pacific Missile Range Facility, Pt. Mugu, California, made possible modification, installation, and operation of the trap for several years.

Under this grant a number of additional modifications were necessary after several test flights in the Pacific area taken by Mr. Eugene Holzapfel, who operated the trap and collected samples of specimens. Also, special devices for collecting material other than arthropods were added, namely, impactor sampler, filter sampler for National Center for Atmospheric Research (NCAR) and University of Hawaii (UH) (chemical analysis of particles); roto-rod sampler for Kansas State University (KSU) and University of Texas (UT) (fungi and algae studies). Other samplers and collaborators who participated in this program are listed on page 15.

Details of flights taken by Mr. Holzapfel, air-borne collecting time, and number of insects trapped are shown on pages 5-14. Flying time during the entire period of the grant totaled 1,001 hours, resulting in 103 specimens of arthropods summarized below:

CLASS INSECTA

	No. of Specimens
Order Diptera	
Family Chironomidae	45
" Ephydridae	4
" Ceratopogonidae	4
" Sciaridae	3
" Agromyzidae	1
" Scatopsidae	1
Fragments	5
	63

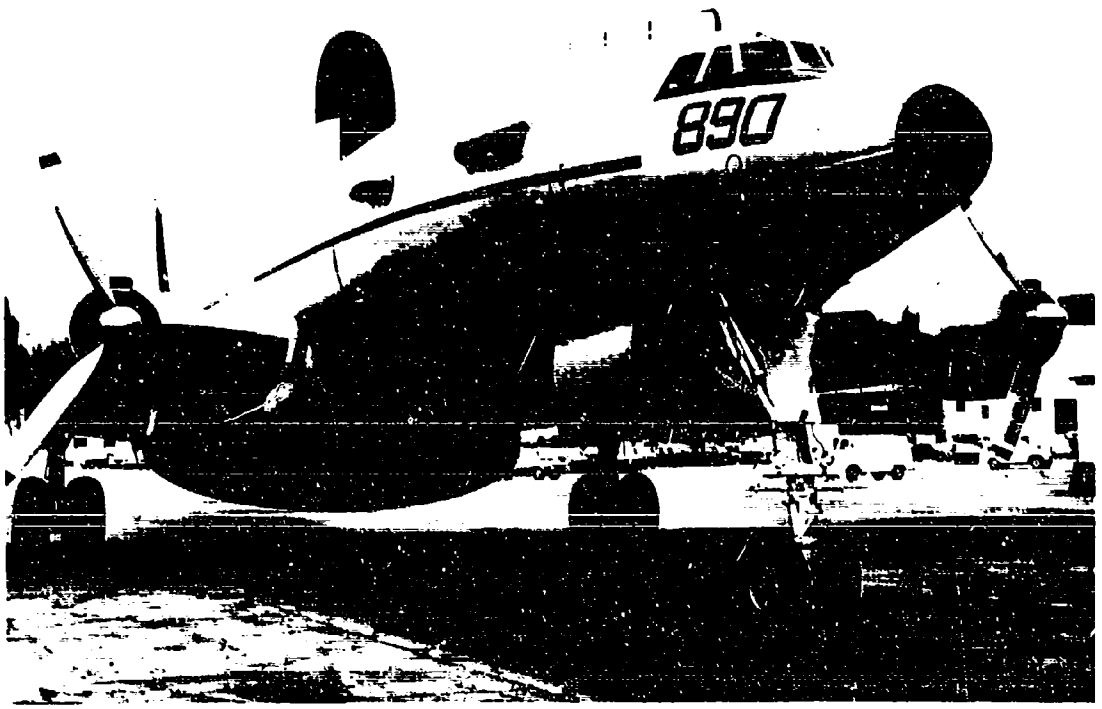

Fig. 1

Courtesy, U.S. Naval Missile Center
Point Mugu, California
Official U.S. Navy Photograph
Not Protected
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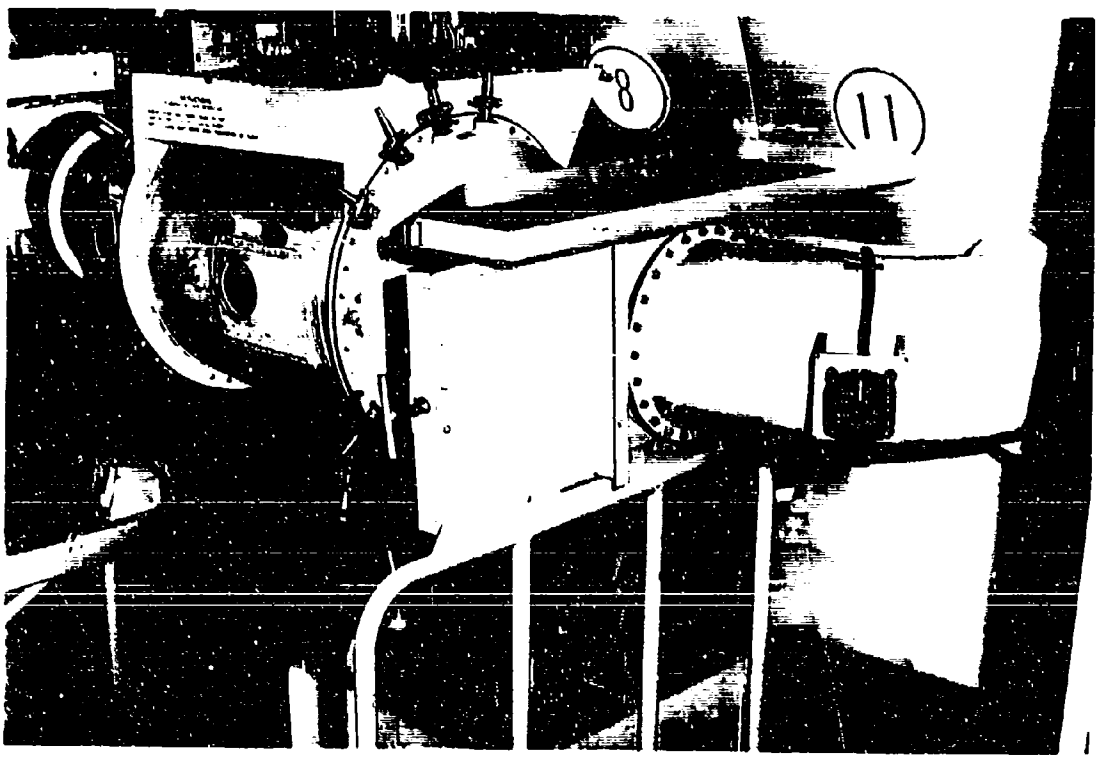

Fig. 2

Courtesy of Naval Missile Center
Point Mugu, California
Official U.S. Navy Photograph
Not for Publication
Unless Officially Released

	No. of Specimens	
Order Hymenoptera		
Family Agaontidae	5	
" Pteromalidae	1	
" Braconidae	1	
" Eulophidae	2	
Fragments	1	
		10
Order Hemiptera		
Suborder Homoptera		
Family Aphididae	4	
Fragments	1	
Suborder Heteroptera		
Family Lygaeidae	3	
Fragments	1	
		9
Order Thysanoptera		
Family Thripidae	1	
" ?	5	
		6
Order Coleoptera		
Family Cucujidae	2	
" Staphylinidae	2	
		4
Order Psocoptera		
Family ?	2	
		2
Order Lepidoptera		
Family Noctuidae	1	
" Tineidae	1	
		2
Order: Unknown		
Wing fragment	1	
Specimen escaped	1	
		2
CLASS ARACHNIDA		
Order Araneida	5	
		5
Total		103

In addition, 12 specimens of insects were found in debris or found alive in aircraft, one of which is questionable as to where it was trapped.

Determinations of samples (43 to NCAR; 15 to JT; 8 to KSU; 12 to UH; 5 to Adelphi U.; 9 to North Texas State U.; 8 to U. of Washington) other than arthropods, are still in progress and to date results have not been received from collaborators.

A combined manuscript reporting all results of the trapping program under this grant for publication in the journal Pacific Insects published by the Dept. of Entomology, Bishop Museum, is in preparation by Mr. Holzapfel. Reprints will be furnished to the Air Force Office of Scientific Research.

SUMMARY OF AIR PLANKTON RETRIEVER FLIGHTS TAKEN IN 1966

DEPARTURE LOCAL DATE	FLIGHT FROM:	TO:	AIR-BORNE COLLECTING TIME HOURS	MINUTES	NUMBER OF INSECTS
?/X	Pt. Mugu*	Text flights	?	?	0
Totals for the month of OCTOBER:			?	?	0
		Flight time used to check the installation. All functioned well so the balance of the time was used to check the air flow rates.			
3/XI	Pt. Mugu	Kaneohe	11	0	0
8/XI	Kaneohe	Operation	2	10	0
11/XI	Kaneohe	Operation	4	15	0
17/XI	Kaneohe	Pt. Mugu	10	55	0
29/XI	Pt. Mugu	Operation	2	20	0
Totals for the month of NOVEMBER:			33	40	0
		Air flow rates continued to be monitored at various points in the duct during the entire month. During most of this monitoring the air was also being screened for insects.			
1/XII	Pt. Mugu	Operation	4	10	0
8/XII	Pt. Mugu	Barbers Pt.	10	45	0
9/XII	Barbers Pt.	return (engine trouble)	7	15	2 (+Fragment)
11/XII	Barbers Pt.-Wake Island		9	40	0
13/XII	Wake Island-Guam		6	45	0
17/XII	Guam	Operation	11	40	1
19/XII	Guam	Wake Island	6	30	1
19/XII	Wake Island-Johnston Atoll		9	45	0
20/XII	Johnston	Barbers Pt.	3	40	0
21/XII	Barbers Pt.-Operation		10	30	0
21/XII	Barbers Pt.-Pt. Mugu		10	35	0
Totals for the month of DECEMBER			91	15	4
TOTALS FOR 1966			124	55	4

*Key to the abbreviated landing areas listed above:

Pt. Mugu	Point Mugu Pacific Missile Range and Naval Air Station, California
Kaneohe	Kaneohe Marine Corps Air Station, Island of Oahu, Hawaii
Barbers Pt.	Barbers Point Naval Air Station, Island of Oahu, Hawaii

SUMMARY OF AIR PLANKTON RETRIEVER FLIGHTS TAKEN IN 1967

DEPARTURE LOCAL TIME	FLIGHT FROM:	TO:	AIR-BORNE COLLECTING TIME HOURS	MINUTES	NUMBER OF INSECTS
29/I	Pt. Mugu	Barbers Pt.	12	33	1 (Fragments)
Totals for the month of JANUARY:			12	33	1 (Fragments)
10/II	Kaneohe	Operation	4	15	0
14/II	Kaneohe	Operation	2	35	0
15/II	Kaneohe	Operation	4	05	0
17/II	Kaneohe	Operation	2	25	0
21/II	Kaneohe	Operation	2	00	0
Totals for the month of FEBRUARY:			15	20	0
2/III	Kaneohe	Operation	7	50	0
4/III	Kaneohe	Operation	11	20	0
13/III	Kaneohe	Pt. Mugu	12	35	0
28/III	Pt. Mugu	Operation	3	00	0
Totals for the month of MARCH:			34	45	0
3/IV	Pt. Mugu	Operation	6	15	0
4/IV	Pt. Mugu	Operation	4	00	0
5/IV	Pt. Mugu	Operation	3	20	0
15/IV	Pt. Mugu	Operation	7	30	0
16/IV	Pt. Mugu	Operation	4	25	0
17/IV	Pt. Mugu	Operation	4	30	0
18/IV	Pt. Mugu	Operation	6	10	0
19/IV	Pt. Mugu	Operation	11	50	0
27/IV	Pt. Mugu	Operation	5	20	2
27/IV	Pt. Mugu	Operation	5	25	0
Totals for the month of APRIL:			58	45	2
15/V	Pt. Mugu	Operation	3	00	1
16/V	Pt. Mugu	Operation	3	20	1
17/V	Pt. Mugu	Operation	4	15	1
18/V	Pt. Mugu	Operation	7	24	2

SUMMARY OF AIR PLANKTON RETRIEVER FLIGHTS TAKEN IN 1967

DEPARTURE LOCAL TIME	FLIGHT FROM:	TO:	AIR-BORNE COLLECTING TIME HOURS	MINUTES	NUMBER OF INSECTS
May(con't.)					
19/V	Pt. Mugu	Operation	9	10	0
20/V	Pt. Mugu	Operation	5	20	0
22/V	Pt. Mugu	Operation	4	35	0
29/V	Pt. Mugu	Operation	9	55	0
Totals for the month of MAY:			47	00	5
4/VI	Pt. Mugu	Operation	9	15	0
Totals for the month of JUNE:			9	15	0
5/VII	Pt. Mugu	Barbers Pt.	10	15	9
6/VII	Barbers Pt.	Kwajalein	9	40	0
8/VII	Kwajalein	Barbers Pt.	11	20	0
13/VII	Barbers Pt.	Kwajalein	10	05	0
15/VII	Kwajalein	Operation	3	10	0
20/VII	Kwajalein	Operation	2	28	0
21/VII	Kwajalein	Kaneohe	13	07	3
23/VII	Kaneohe	Pt. Mugu	12	58	1
Totals for the month of JULY:			75	03	13
14/VIII	Pt. Mugu	Operation	6	05	1 (Fragment)
21/VIII	Pt. Mugu	North Island	1	15	2
22/VIII	North Island	Operation	9	45	0
23/VIII	North Island	Operation	3	03	0
28/VIII	North Island	Pt. Mugu	0	55	1
Totals for the month of AUGUST:			21	03	4
4/IX	Pt. Mugu	Barbers Pt.	11	05	1
5/IX	Barbers Pt.	Wake Island	9	45	0
5/IX	Wake Island	Guam	6	20	2
8/IX	Guam	Townsville, Australia	11	35	0
13/IX	Townsville	Sydney	4	45	0
14/IX	Sydney	Samoa	12	55	0

DEPARTURE LOCAL TIME	FLIGHT FROM:	TO:	AIR-BORNE COLLECTING TIME HOURS	MINUTES	NUMBER OF INSECTS
Sept.(con't.)					
15/IX	Samoa	Barbers Pt.	11	00	0
16/IX	Barbers Pt.	Pt. Mugu	12	25	0
21/IX	Pt. Mugu	Operation	4	15	0
21/IX	Pt. Mugu	Operation	7	25	0
25/IX	Pt. Mugu	Barbers Pt.	10	55	1
26/IX	Barbers Pt.	Operation	5	45	0
29/IX	Barbers Pt.	Pt. Mugu	11	32	0
Totals for the month of SEPTEMBER:			119	45	4
10/X	Pt. Mugu	Operation	5	40	1
30/X	Pt. Mugu	Operation	4	15	0
Totals for the month of OCTOBER:			9	55	1
6/XI	Pt. Mugu	Operation	7	40	3(+fragments)
8/XI	Pt. Mugu	Barbers Pt.	10	35	2(+fragments)
10/XI	Barbers Pt.	Operation	9	45	0
11/XI	Barbers Pt.	Pt. Mugu	10	25	0
28/XI	Pt. Mugu	Operation	3	45	0
29/XI	Pt. Mugu	Operation	7	35	3
30/XI	Pt. Mugu	Operation	3	15	0
Totals for the month of NOVEMBER			56	03	8
3/XII	Pt. Mugu	Barbers Pt.	11	25	2
4/XII	Barbers Pt.	Kwajalein	10	25	0
6/XII	Kwajalein	Operation	3	45	0
6/XII	Kwajalein	Barbers Pt.	10	15	0
9/XII	Barbers Pt.	Pt. Mugu	11	10	0
18/XII	Pt. Mugu	Barbers Pt.	12	45	0
19/XII	Barbers Pt.	Kwajalein	10	20	0
21/XII	Kwajalein	Operation	2	50	0

SUMMARY OF AIR PLANKTON RETRIEVER FLIGHTS TAKEN IN 1967

DEPARTURE LOCAL TIME	FLIGHT FROM:	TO:	AIR-BORNE COLLECTING TIME HOURS	MINUTES	NUMBER OF INSECTS
December(con't.)					
21/XII	Kwajalein	Operation	2	10	0
22/XII	Kwajalein	Barbers Pt.	10	15	0
23/XII	Barbers Pt.	Pt. Mugu	10	20	0
Totals for the month of DECEMBER:			95	40	2
SUMMARY OF TOTALS FOR 1967:		January	12	33	1
		February	15	20	0
		March	34	45	0
		April	58	45	2
		May	47	00	5
		June	9	15	0
		July	73	03	13
		August	21	03	4
		September	119	45	4
		October	9	55	1
		November	56	03	8
		December	95	40	2
Totals for the year			553	07	40

Key to the abbreviated landing areas listed above:

Pt. Mugu-------Point Mugu Pacific Missile Range and Naval Air Station, California
Barbers Pt.----Barbers Point Naval Air Station, Island of Oahu, Hawaii
Kaneohe--------Kaneohe Marine Corps Air Station, Island of Oahu, Hawaii
Operation------Any flight returning to the same landing strip.
Kwajalein------Kwajalein Nike Site, Kwajalein Atoll, Marshall Islands
North Island---North Island Naval Air Station, California (near San Diego)
Wake Island
Guam-----------Agana Naval Air Station, Guam, Marianas Islands
Townsville-----AARF Base, Townsville, Australia
Sydney---------International Airport, Sydney, Australia
Samoa----------International Airport, American Samoa (near Pago Pago)

SUMMARY OF AIR PLANKTON RETRIEVER FLIGHTS TAKEN IN 1968

DEPARTURE LOCAL TIME	FLIGHT FROM:	TO:	AIR-BORNE COLLECTING TIME HOURS	MINUTES	NUMBER OF INSECTS
11/I	Pt. Mugu	Operation	10	15	0
19/I	Pt. Mugu	Operation	7	05	0
Totals for the month of JANUARY:			17	20	0
15/II	Pt. Mugu	Operation	2	05	0
23/II	Pt. Mugu	Operation	2	00	1
25/II	Pt. Mugu	Barbers Pt.	12	05	2 (+fragment)
26/II	Barbers Pt.	Johnston Atoll	3	55	3
26/II	Johnston--Op.--Barbers Pt.		14	50	0
29/II	Barbers Pt.	Vandenburg AFB	10	15	1
Totals for the month of FEBRUARY:			41	15	7
1/III	Vandenberg	Pt. Mugu	0	45	0
12/III	Pt. Mugu	Kaneohe	11	25	0
14/III	Johnston Atoll-Kwajalein		13	45	0
17/III	Kwajalein	Operation	2	45	0
17/III	Kwajalein	Barbers Pt.	10	40	2
18/III	Barbers Pt.	Pt. Mugu	9	55	0
Totals for the month of MARCH:			49	15	2
2/IV	Pt. Mugu	Barbers Pt.	10	45	2
3/IV	Barbers Pt.	Kwajalein	9	50	0
5/IV	Kwajalein	Operation	2	35	0
6/IV	Kwajalein	Eniwetok	2	20	0
6/IV	Eniwetok	Operation	1	30	0
8/IV	Eniwetok	Kwajalein	2	00	0
9/IV	Kwajalein	Eniwetok	2	15	0
9/IV	Eniwetok	Operation	0	45	0
9/IV	Eniwetok	Kwajalein	2	15	0
12/IV	Kwajalein-Op.--Barbers Pt.		14	20	0
15/IV	Barbers Pt.	Pt. Mugu	11	40	2
Totals for the month of APRIL:			60	05	4

SUMMARY OF AIR PLANKTON RETRIEVER FLIGHTS TAKEN IN 1968

DEPARTURE LOCAL TIME	FLIGHT FROM:	TO:	AIR-BORNE COLLECTING TIME HOURS	MINUTES	NUMBER OF INSECTS
5/V	Pt. Mugu	Barbers Pt.	10	45	0
6/V	Barbers Pt.	Kwajalein	10	55	0
8/V	Kwajalein	Operation	5	55	0
11/V	Kwajalein	Operation	5	25	0
15/V	Kwajalein	Operation	4	35	0
15/V	Kwajalein	Barbers Pt.	10	45	2 (+fragments)
16/V	Barbers Pt.	Pt. Mugu	10	20	4 (+fragments)
21/V	Pt. Mugu	Operation	4	55	0
23/V	Pt. Mugu	Operation	8	15	0
Totals for the month of MAY:			71	50	6
4/VI	Pt. Mugu	Operation	7	45	0
15/VI	Pt. Mugu	Operation	3	25	1 (fragments)
16/VI	Pt. Mugu	Operation	8	55	7 (+fragments)
20/VI	Pt. Mugu	Operation	10	25	0
Totals for the month of JUNE:			28	30	8
10/VII	Pt. Mugu	Operation	2	28	0
11/VII	Pt. Mugu	Operation	5	00	0
23/VII	Pt. Mugu	Barbers Pt.	11	00	0
25/VII	Barbers Pt.	Operation	6	30	0
Totals for the month of JULY			24	58	0
2/VIII	Barbers Pt.	Hilo	1	15	0
2/VIII	Hilo	Barbers Pt.	1	10	0
4/VIII	Barbers Pt.	Pt. Mugu	11	20	0
12/VIII	Pt. Mugu	Kaneohe	10	40	16
15/VIII	Kaneohe	Operation	7	25	0
18/VIII	Kaneohe	Pt. Mugu	10	55	0
27/VIII	Pt. Mugu	Kaneohe	11	25	14
28/VIII	Kaneohe	Operation	8	30	0

SUMMARY OF AIR PLANKTON RETRIEVER FLIGHTS TAKEN IN 1968

DEPARTURE LOCAL TIME	FLIGHT FROM:	TO:	AIR-BORNE COLLECTING TIME HOURS	MINUTES	NUMBER OF INSECTS
30/VIII	Kaneohe	Pt. Mugu	12	20	0
Totals for the month of AUGUST: (See previous page)			75	00	30
19/IX	Pt. Mugu	North Island	1	05	0
20/IX	North Island	El Paso International	3	20	0
21/IX	El Paso	Norfolk NAS	7	38	0
23/IX	Norfolk NAS	Kennedy International	2	10	1
Totals for the month of SEPTEMBER:			14	13	1

Once at the PAR section of Lockheed at the Kennedy International Airport on Long Island New York, 890 remained for the balance of the year--hence no flight time during the months of October, November and December.

SUMMARY OF TOTALS FOR 1968:				
	January	17	20	0
	February	41	15	7
	March	49	15	2
	April	30	05	4
	May	71	50	6
	June	26	50	8
	July	24	58	0
	August	25	00	30
	September	14	13	1
	October	00	00	0
	November	00	00	0
	December	00	00	0
Totals for the year		262	23	58

SUMMARY OF AIR PLANKTON RETRIEVER FLIGHTS TAKEN IN 1969

DEPARTURE LOCAL TIME	FLIGHT FROM:	TO:	AIR-BORNE COLLECTING TIME HOURS	MINUTES	NUMBER OF INSECTS
31/I	Kennedy International--N.Y.C.	Dyess AFB, Texas	8	15	0
Totals for the month of JANUARY:			8	15	0
1/II	Dyess AFB, Texas	Pt. Mugu	5	15	0
4/II	Pt. Mugu	Barbers Pt.	11	35	1
15/II	Barbers Pt.	Pt. Mugu	10	40	0
19/II	Pt. Mugu	Operation	2	55	0
Totals for the month of FEBRUARY:			30	25	1
7/III	Pt. Mugu	North Island	1	05	0
8/III	North Island	Pt. Mugu	0	50	0
Totals for the month of MARCH:			1	55	0

9/IV and 21/IV: Local flights were made near Pt. Mugu. While the collecting device was in operation, the purpose of these flights was to accurately measure the air flow rates. No records were kept of the time and no insects were collected.

22/IV The air plankton retriever was removed from the aircraft.

SUMMARY OF TOTALS FOR 1969:	January	8	15	0
	February	30	25	1
	March	1	55	0
	April--Program terminated			
Totals for the year		40	35	1

SUMMARY OF AIR-BORNE COLLECTING TIME FROM 1966 THROUGH 1969

		Hours	Minutes	Number of Insects
TOTALS FOR 1966	October	?	?	0
	November	33	40	0
	December	91	15	4
	Totals	124	55	4
TOTALS FOR 1967	January	12	33	1 (Fragments)
	February	15	20	0
	March	34	45	0
	April	58	45	2
	May	47	00	5
	June	09	15	0
	July	73	03	13
	August	21	03	4
	September	119	45	4
	October	09	55	1
	November	56	03	8
	December	95	40	2
	Totals	553	07	40
TOTALS FOR 1968	January	17	20	0
	February	41	15	7
	March	49	15	2
	April	60	05	4
	May	71	50	6
	June	28	30	8
	July	24	58	0
	August	75	00	30
	September	14	13	1
	October	00	00	0
	November	00	00	0
	December	00	00	0
		282	23	58
TOTALS FOR 1969	January	08	15	0
	February	30	25	1
	March	01	55	0
	April	?	?	0
		40	35	1
Total for 1966		124	55	4
Total for 1967		553	07	40
Total for 1968		282	23	58
Total for 1969		40	35	1
Total for entire program:		1001	00	103

Air Plankton Sampling Program--------1 January 1969
Amendments to Progress Report: November 1967 and 1 June 1968

Institution	Device	Present Status
Bishop Museum	Insects	*Fully Operational--Active
NCAR	Impactor Sampler	*Rehabilitation completed during summer Fully Operational--Active
NCAR	Filter Sampler	*Sample holder changed during summer. AC power changed to DC in August Fully Operational--Active
U.S.D.A. Kansas State	Roto rod Sampler	Sampler fully Operational No samples supplied to USDA during 1968
U. of Texas	Roto rod Sampler	Sampler fully Operational Dr. Brown on leave in Germany No samples supplied after 1 July 1968
U. of Texas	Anderson Media Sampler	Eliminated from Program Dr. Brown on leave in Germany
U. of Hawaii Duce	Filter Sampler (See NCAR above)	*Fully Operational--Active
Kansas State	Kramer Sampler	*Fully Operational--Active AC power changed to DC in August
Desert Res. Inst.	Cn Counter	Not available Will probably never be used.
U. of Hawaii Buddenhagen	Roto rod Sampler (See USDA above)	Fully Operational--Inactive No samples supplied during 1968
	Filter Sampler (See NCAR above)	Fully Operational--Inactive No samples supplied to date
U. of Washington & Smithsonian	Filter Sampler (See NCAR above)	*Fully Operational--Active
Adelphi U.	Filter Sampler (See NCAR above)	*Fully Operational--Active
North Texas State	Filter Sampler (See NCAR above)	Fully Operational--Inactive Dr. Schlichting on leave in Ireland
U. of Florida	Roto rod Sampler (See USDA above)	Specially prepared slides to be used experimentally in late January 1969 *Operational--Active
	Filter Sampler (See NCAR above)	*Fully Operational--Active
Florida State	Filter Sampler (See NCAR above)	Fully Operational--Active New participant--Dr. Collier No samples supplied to date

Active participants in the program as of 1 January 1, 1969

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
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13. ABSTRACT

During the two-and-a-half year period of this grant from the Air Force Office of Scientific Research, Mr. Eugene Holzapfel made arrangements for the modification of the air plankton retriever and its installation on a WV-2 aircraft of the Pacific Missile Range Facility, based at Pt. Mugu, California. He operated the air plankton retriever as well as other sampling devices for the purpose of collecting all types of air-borne organisms and particles in the Pacific area. The primary objective of the Museum's program was trapping air-borne arthropods to further test the theory of natural air dispersal of arthropods to oceanic islands. Numerous flights totalling 1,001 hours of flying time were taken which resulted in trapping 103 specimens of arthropods represented in eight major orders. Determinations of samples, other than arthropods, are still in progress by collaborators.

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KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Air dispersal studies						
Air-borne arthropods						
Trapping of air-borne organisms						
Atmospheric research						
Air plankton retriever						
Aerobiology						

Unclassified

Security Classification